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(58) Field of search

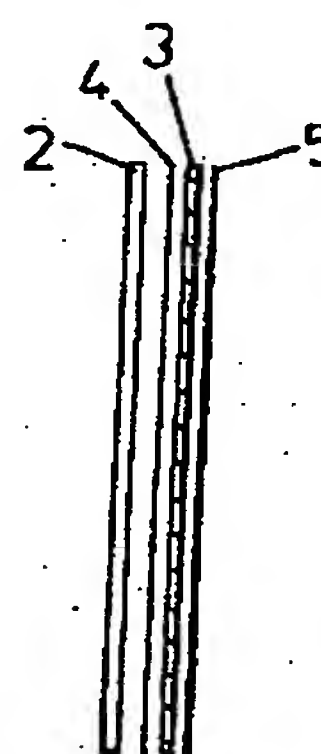
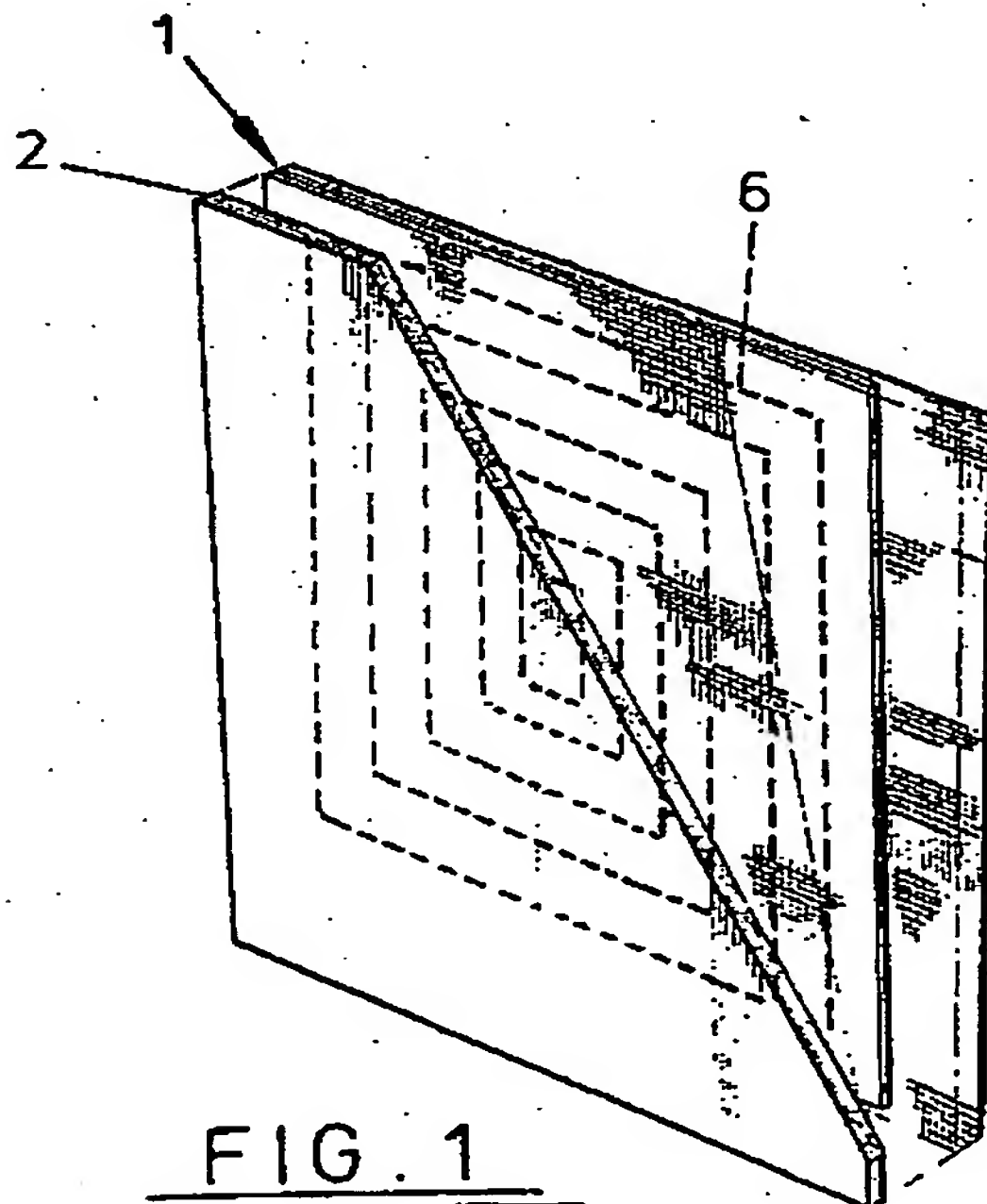
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(54) Anti-ballistic body armour

(57) A trauma attenuation pack 1 for use in flexible body armour comprises a plastics panel 3 (eg. of polypropylene) having on at least one side thereof a layer 4, 5 of a ballistic fabric securely affixed to the panel. A ballistic projectile impacting on the flexible body armour causes deformation of the panel 3 as well as possible breakage of the fibres of the ballistic fabric resulting in absorption of energy thereby reducing the deformation (or bulging) on the side of the armour adjacent the body. The layers may be united by stitching, preferably in a spiral pattern or by spot bonding.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

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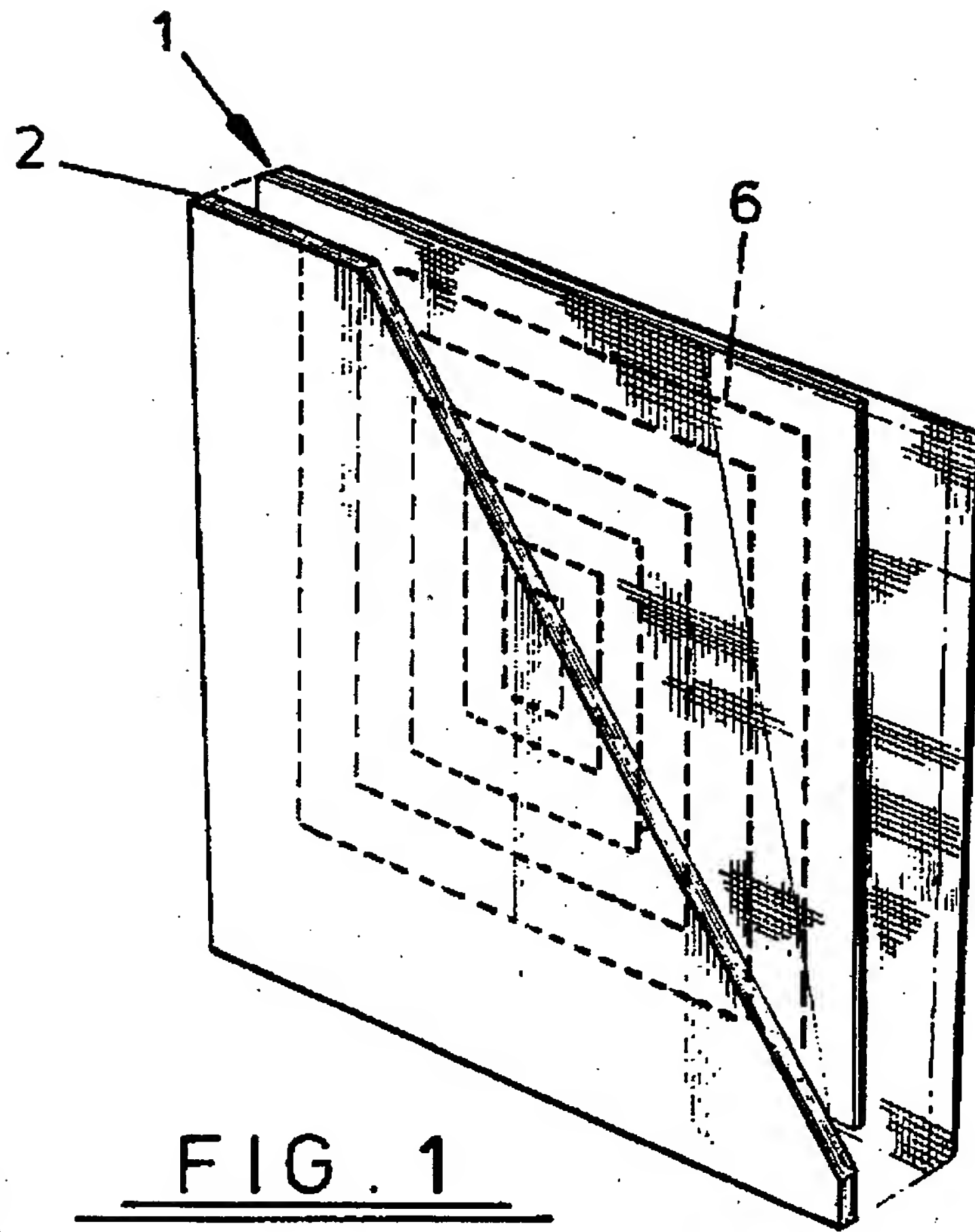


FIG. 1

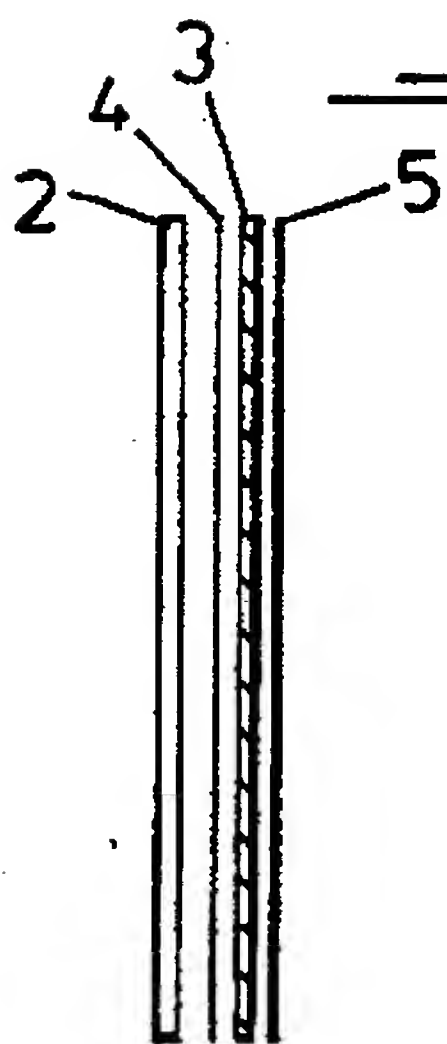


FIG. 2

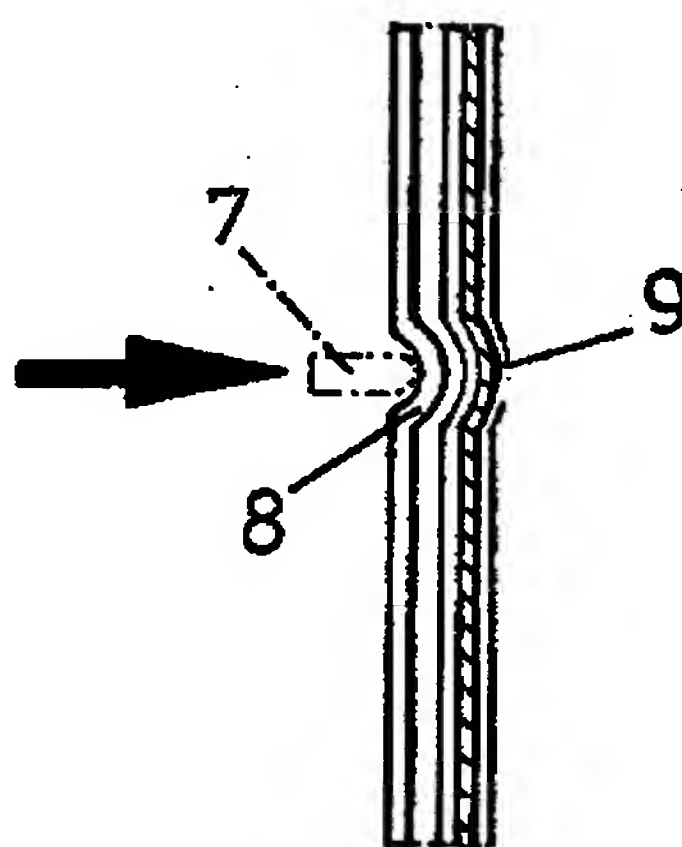


FIG. 3

### TRAUMA ATTENUATION PACK

The present invention relates to a trauma attenuation pack for use in flexible body armour, as well as to flexible body armour incorporating such a pack.

It is well known for flexible body armour to comprise multiple layers of ballistic fabric, usually ballistic nylon or KEVLAR (Registered Trade Mark) which are effective for preventing passage of a bullet therethrough. However the impact of the bullet on the flexible armour can cause significant deformation (ie. bulging) on the rear side of the fabric. This deformation can itself result in rupture of vital organs of the body (the blunt trauma) and tests have been conducted to determine the maximum permissible deformation which can occur when the ballistic fabric is struck by a bullet. The National Institute of Justice (US) specification stipulates that the deformation should not exceed 44mm, whereas tests in the UK have suggested that 25mm is a safer maximum. KEVLAR and other ballistic fabrics will meet such requirements if sufficient layers are present but this produces a garment which is bulky and stiff. In order that a lesser number of layers of the ballistic fabric may be used, it is known to use a trauma attenuation pack behind the layers of ballistic fabric. The trauma pack is effective in limiting the deformation of body armour resulting from the impact of a bullet. Existing trauma attenuation pack include duck down (which may make the armour bulky and obtrusive) or polycarbonate in combination with a foam material (which once again may provide unacceptable bulk).

According to the present invention there is provided a trauma attenuation pack for use in flexible body armour, the pack comprising a panel of a

deformable plastics material having a layer of ballistic fabric securely affixed to at least one side of the panel.

The present invention also provides flexible body armour comprising multiple layers of a ballistic fabric secured together, and a trauma attenuation pack as defined in the preceding paragraph behind said layers.

If the trauma attenuation pack has ballistic fabric secured to only one face of the plastic panel then the pack should be positioned in the body armour such that the fabric is on the face of the panel remote from the multiple layers of ballistic fabric. Preferably however, the panel will have a layer of ballistic fabric secured to each face thereof, eg. by stitching.

Preferably the plastics material is a thermoplastic which may readily be shaped so as to provide a pack which is conformed to the body of a user and therefore comfortable to wear.

The plastics material is preferably polypropylene.

The invention will be further described by way of example only with reference to the accompanying drawings, in which

Fig. 1 is a partially cut away perspective view of one embodiment of trauma attenuation pack in accordance with the invention positioned behind multiple layers of a ballistic fabric;

Fig. 2 is a side view of Fig. 1 but with layers being shown separated for the purpose of clarity; and

Fig. 3 is similar to Fig. 2 but additionally showing the effect of impact by a bullet.

Referring to Fig. 1, there is illustrated a trauma attenuation pack 1 located behind a panel 2 of multiple layers of woven KEVLAR fabric. The pack 1

comprises a panel 3 of polypropylene (preferably about 1.5mm thick) provided on each face thereof with a layer of 4,5 of a ballistic fabric material (eg. ballistic nylon having a specific weight of ca 300g m<sup>-2</sup>, or an aramid such as KEVLAR). The layers 4,5 of ballistic fabric are fixed to the panel 3 by stitching 6. In the illustrated embodiment, a spiral form of stitching is used but other stitching patterns may also be used. It is also possible that other methods of fixing the layers 4,5 to the panel 3 by other means, eg. bonding by means of an adhesive or by the use of heat to form 'spot bonds' between the fabric and the panel.

For the purpose of simplicity, the pack 1 and panel 2 are shown as being rectangular. Obviously however they will in practice have shapes which are most suitable for use in flexible body armour. Moreover the pack 1 and panel 2 are separate so that the pack 1 may be removed from the flexible body armour if and when required.

Consider now that the panel 2 is struck by a bullet 7. This bullet does not pass through the panel 2, but does result in a comparatively large deformation 8 on the rear surface thereof.

The pack 1 is located immediately behind the panel 2 and serves to absorb a significant proportion of the energy of the expanding deformation 8 with the result that a shallower deformation 9 is produced at the rear of the pack 1. In more detail, this energy is absorbed partly by the deformable polypropylene, but excessive deformation of the polypropylene is prevented because it is securely affixed (by the stitching 6) to the layers of the non-stretchable ballistic fabric 4,5. These layers, and particularly the rear layer 5, serve to absorb further energy, and in fact the rear layer 5 may be ruptured (as depicted

in Fig. 3) showing that energy has been absorbed in breaking the threads of the fabric.

The pack 1 has the advantage of being cheap and easy to construct, as well as being light for the wearer. Furthermore, the pack 1 is relatively thin, ca 1.5-2mm, and therefore unobtrusive.

A further significant advantage of the pack results from the fact that polypropylene is a thermoplastic which may be reversibly softened by immersion in hot water. This allows a user of the panel to soften the panel easily and then contour it to conform to his or her body shape so that the panel will be comfortable to wear.



CLAIMS

1. A trauma attenuation pack for use in flexible body armour, the pack comprising a panel of a deformable plastics material having on at least one side thereof a layer of a ballistic fabric securely affixed to the panel.
2. A pack as claimed in claim 1 wherein attached both sides of the panel have ballistic fabric securely affixed thereto.
3. A pack as claimed in claim 1 or 2 wherein the ballistic fabric is a ballistic nylon.
4. A pack as claimed in claim 1 or 2 wherein the ballistic fabric is comprised of an aramid.
5. A pack as claimed in any one of claims 1 to 4 wherein the ballistic fabric is secured to the panel by stitching.
6. A pack as claimed in claim 5 wherein the stitching is in a spiral pattern.
7. A pack as claimed in any one of claims 1 to 4 wherein the ballistic fabric is bonded to the panel.
8. A pack as claimed in any one of claims 1 to 7 wherein the panel is of a thermoplastic material.
9. A pack as claimed in claim 8 wherein the panel is of polypropylene.
10. A trauma attenuation pack substantially as hereinbefore described with reference to the

accompanying drawings.

11. Flexible body armour incorporating trauma attenuation pack as claimed in any one of claims 1 to 10 positioned in the armour such that a layer of ballistic fabric is on the body side of the armour.